

Obtaining Historic Timber Repair Viewpoints: Understanding The Contractor And Conservator Collaboration In Malaysian Building Conservation

Afzanizam Muhammad^{1*}, Norashikin Abdul Karim¹,
Azizul Azli Ahmad², Nordin Misnat³

Universiti Teknologi MARA, Perak Branch, 32610, Seri Iskandar, Perak, Malaysia

*Corresponding Author: afzan497@uitm.edu.my

Abstract: *Conservation is the work to restore a heritage building, which differs from upgrading, renovating or new extension. Conservation is an action to save historical evidence embodied in a historic building. Awareness of conserving historic buildings in Malaysia is considered recent compared to Western countries. On-site conservation in Malaysia, the conservators always work with professionals from various backgrounds, especially the contractors, who usually appoint a few more sub-contractors who are more specialists in building materials. Carpenters and craftsmen are among the sub-contractors involved in historic timber repairs. The Heritage Department of Malaysia authorises the conservators in Malaysia based on their deep understanding and experience in repair works of historic buildings and monuments. The conservator's role is to cooperate with the contractor in the repairs by providing details work instructions as a guide to the contractor at the site. Typical contractors are experts in building construction and repairs but not in preserving the buildings' values and historical evidence embodied. The destructive mistakes during the repair work are a significant loss of authenticity. Therefore, conservators need to understand the contractors' viewpoint, especially that first timer in repairing heritage buildings. This paper presents the contractor's and conservator's viewpoint differences in conservation work through interviews and observation surveys from previous and ongoing conservation projects in Malaysia. Understanding both parties' viewpoints is one of the success factors in repairing the heritage building timber elements. It is crucial to provide an effective workflow for the contractor and reduce repair work mistakes and overlooks to avoid significant value loss.*

Keywords: Conservation, Historic Timber, Replacement Timber, Repair, Conservator, Contractor

1. Introduction

Building conservation helps to keep and monitor the heritage building from being destroyed or restored without systematic planning and management. Building conservation involves preserving the original condition and heritage sites and sustaining their cultural values as best as possible. The conservation process is an extension of the age of the building so that the building remains functional (National Heritage Act 645, 2005). The main purpose of conservation is to safeguard cultural significance by maintaining appropriate materials conservation to prolong the lifespan and function of the building. Building conservation is always associated with heritage buildings that are old and historical. Heritage buildings are a valuable asset with significance in materials, construction, architecture and the history behind the construction. Those buildings' cultural values can investigate, translated, studied, and

emulate. A new generation can understand the local's historical backgrounds through the preserved historic buildings.

According to Feilden (2003), historic buildings contain values such as architectural uniqueness, historical significance, community cultural value, builder skills, and the value of emotions experienced by visitors and local communities and a great value to the country. That information is embedded within the building structure. Therefore, heritage building conservation must first involve an investigation of their historical significance in local culture that is reflected through the construction of the building to imbody the values.

The repaired historic timber structure should reflect the original construction (ICOMOS, 2017). The historic timber building contains information on the knowledge of previous generations (Feilden, 2003). Preserving the heritage timber building is essential as reference material for the next generation to recognise the local background and cultural values. It is necessary to conserve heritage timber buildings because the embedded intangible information, including the craftsmanship, the know-how, the techniques, and the skill of the builders, are unique to their place (Karakul, 2015).

2. Historic Timber

Timber is an organic material that may decay and degrade rapidly compared to other popular materials in historic buildings, such as stone or masonry (Larsen & Marstein, 2016). However, the proper care and maintained timber buildings have been historically worldwide and proven long-lasting for thousands of years due to decay prevention. An old timber building with poor maintenance or one that has long been derelict always faces many deterioration factors. Thus, the historic timber building hundreds of years old is highly likely to have been exposed to the decaying agent for a long time. The defective timber structure directly reduces its performance. Therefore, the strength and the physical appearance of the old timber buildings cannot be expected to be the same as new timber, even among the same species. Thus, the maintenance of the old timber building's structure is also different from the newly constructed timber.

The 'historic timber' defined by the ICOMOS Wood Committee (1999) and Larsen and Marstein (2016) are all types of timber built either wholly or partially of cultural significance or represent parts of the historical era. In other words, historic timber or old building can be safeguarded through conservation work due to their significance to the locals' values. Therefore, in this research, the term 'historic timber' refers to the original timber that remained in the heritage buildings. While the 'replacement timber' is used in repairs to replace the damaged historic timber. In global practice, the replacement timber is always from the same species or most similar quality as the original structure.

The historic timber term has introduced by ICOMOS (1999), and it has been adopted by many prominent scholars, including Larsen and Marstein (2016) and Yeomans (2003). They have elaborated on the significance of historic timber in buildings and how the timber can be preserved through repair techniques. The preservation of the historic timber structure should concern several reasons related to culture and history. Every historic building that has been built represents a certain period era. The era during which the historic buildings were built is closely related to the original materials used. The materials and their construction techniques represent the era or style period. Most historic buildings are renovated and extended from time to time, incorporating layers from different period styles and utilising building materials salvaged from other, earlier buildings (Orbasli, 2008). The materials used on buildings are associated with established trade relations with other places in the past. In other words, the original material, such as a timber species, can provide historical information about

the building and the locals. Analysis of differences in craftsmanship over the building's past can identify the modification made or extensions added in specific periods in the past.

The timber structure's construction techniques and design can give a clear clue about the past technology. Even the old carpenter's setting marks on the timber provide information about the whole process, from the log conversion to lumber till the construction to the building structure (Yeomans, 2008). Yeomans (2008) added that the development of the additional structure on the historic building is evidence of craft practice, and the timeline can be traced. In other words, the building's old extensions or renovation phases through history can be drawn. Historic timber carpenters sometimes marked their date and work information (Brown, 2013).

Forsyth emphasised that one of the principles of restoring historic buildings is that the region's geology and topography determine its buildings' character and must be respected (Forsyth, 2008). The timber used on the heritage building described the surrounding forest vegetation when it was built (Rashid, 2007). For example, the Seri Menanti Palace in Negeri Sembilan, Malaysia, is among the heritage timber buildings. The palace columns measuring 62 feet tall with approximately one square foot of the section have become a question of how the chengal timber (*Neobalanucarpus Heemi*) was set up during the early 20th century is something wondered (Ibrahim, 2019). At least, at some point, the level of the old technology can be roughly figured out based on the existing construction and materials used. Therefore, the whole set of timber structures, their design, workmanship, and other details need to be considered a piece of historical information. The historical timber structure can be regarded as original preserved records in a physical form embodied in the heritage building that it's impossible to construct today. The historic timber structure of the building is not only physical evidence of the past but may also have played a role in history or is linked to specific events or periods in history. The history embodied within the building fabric was sometimes the only evidence of events and life in the past (Orbasli, 2008). There is a diversity of historic values embodied. That is why the remaining original materials are always prioritised in conservation works. The surface visual character of the historic timber surfaces contributes to the type of sawing tools used. For example, The work of a hand saw can be identified by the distinctive pattern of saw marks, while the use of a hand chisel can be recognised in the craftsmanship of wood joinery in heritage buildings (Source: English Heritage, 2012).

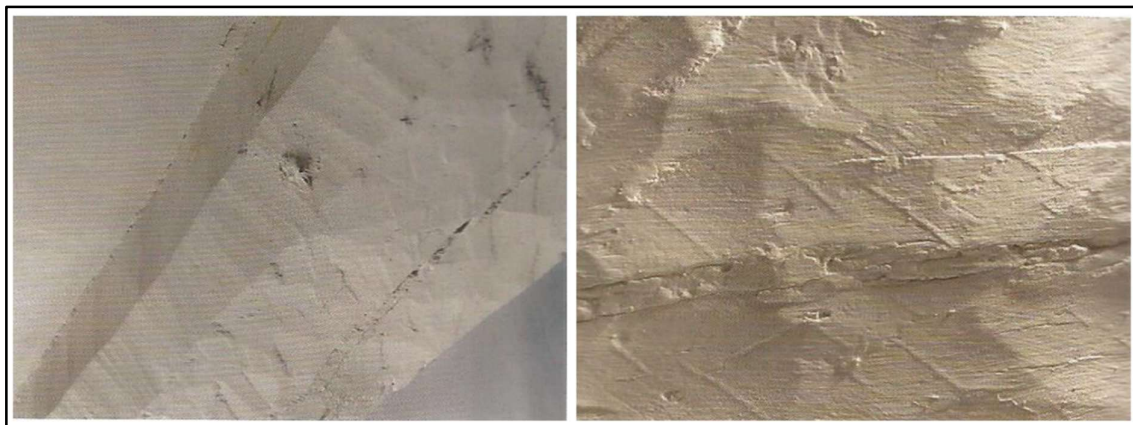


Figure 1: Cutting marks left on historic timber surface determine the past surfacing method uses adze or axe types. (Source: English Heritage, 2012).

Compared to the Western, most Asian countries put greater effort into constructing and caring for buildings and places of worship. They are built of the best timber and to higher standards (Henrichsen, 2004). The timber structure can last hundreds of years and even be weather-resistant. Still, it can last so long due to periodic repair and maintenance. Timber buildings have been very durable, lasting hundreds of years, as evidenced by the many historic timber buildings (Aghayere & Vigil, 2014). In Malaysia, notably, its timber buildings are resistant to hot and wet weather because of the protective design that prevents the building from deterioration agents (Gibbs et al., 1987; Wulf Killmann et al., 1994; Yuan, 2002). Maintaining the original design of the building is a dual action that its first aim is to prolong the building's life and second to preserve the embedded local values (Orbasli, 2008; Worthing & Bond, 2008). Therefore, to ensure that the historic timber building is prolonged, the knowledge of timber deterioration must be understood for maintaining and preserving the historic timber building.

In Malaysia, most of the buildings considered heritage buildings are traditional buildings and those built in the colonial period. Colonial buildings constructed during the British rule of 1800-1930 were mainly built of masonry except for their roof structure and timber floor (Ahmad, 1997; Yuan, 1987a). The rows of old shophouses in Malaysia constructed in that era similarly influenced construction technology (Figure 2). In addition, heritage buildings built around the British colonial era include royal buildings, public buildings, and commercials. Those buildings have timber as part of the construction material, especially for the roof structure, floors, doors and windows, including its decorative elements, even though the walls and columns are made from masonry (Yusof, 2014).

In comparison, traditional Malay buildings are built entirely of timber, of which only some particular species are used as the main structure (Gibbs, Rahman and Kassim, 1987; Sabil and Utaberta, 2017). Therefore, the significant value of these historic timber structures is found in the material and their design and construction technology. The conservation of the building aims to stop its deterioration and, at the same time, save the values embodied (Feilden, 2003; Larsen and Marstein, 2016). In conclusion, all heritage buildings involve historic timber on the structures as a whole or in certain parts. Historic timber is significant as it contains cultural, historical, and technological values that cannot be replaced.

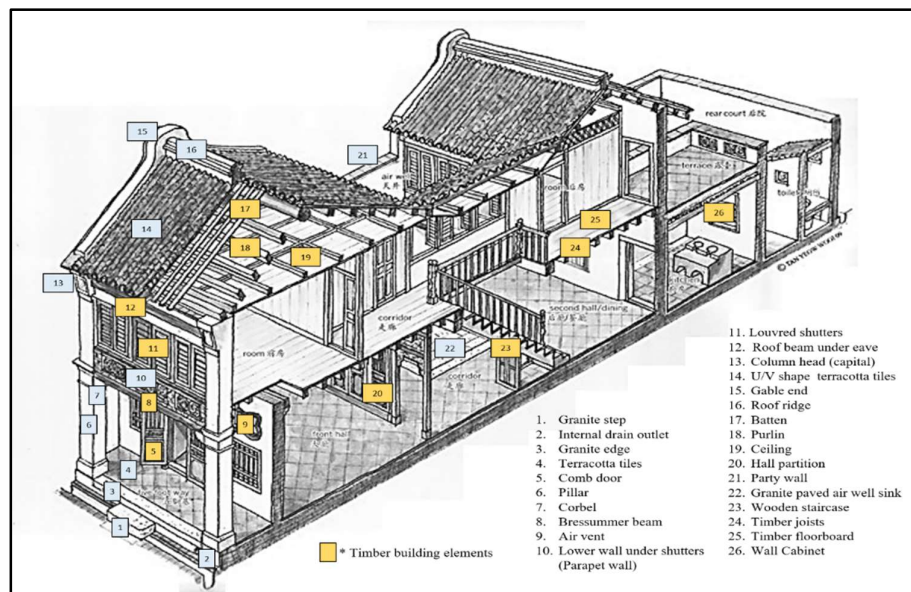


Figure 2: Typical Malaysian masonry shophouse construction that shows timber elements combination.
Adapted from Tan Yeow Wooi (2015)

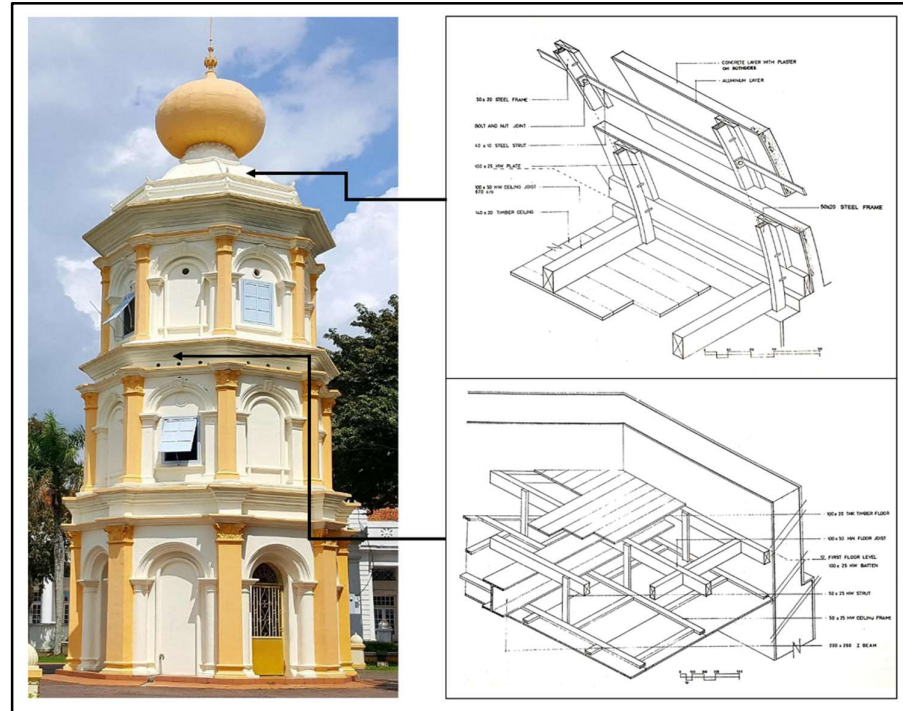


Figure 3: The construction technology of Balai Nobat in Alor Setar, Kedah (1917), during the British colonial era. Top-right: The dome is constructed of timber, concrete, and steel frame. Below-right: The floor system by various steel beams and timber on a masonry wall. Adapted from National Heritage Trust (1998).

There are various carpentry tools around the world, including Western and Japanese. These hand tools that have been used can be identified by analysing the surface of the remaining historic timber. But in Malaysia, the timber expert can generally determine whether the historic timber is from sawmill processing or processed using hand tools. Timber processed from sawmills was first introduced in construction in the early 19th century. For example, in Malay traditional houses, the timber column with an octagonal section is always associated with the handtools ripping technique compared to the column with a square section which usually has a section almost perfectly ripped by power machines in a sawmill. In addition, timber experts can differentiate the surface quality, either hand or machine planer. The timber building built in the 20th century shows the timber processed at the sawmill compared to the previous era, where it was cut and ripped by a sawyer likely sourced from the nearby forest. All of these are significant indigenous records embodied in the historic timber built. It should be respected, preserved and restored for future reference. Therefore, conservation work is not just repairing back to normal building function but also remaining authenticity, which should be understood by every professional involved. This matter needs to be carefully monitored by the conservator because the profit factor is often a priority for some parties, causing the authenticity of the building to be ignored.

3. Historic Timber Repair Works

Repairing historic timber structures differs from typical timber building repair or new construction. It follows conservation principles, emphasising reversibility and compatibility between historic and new materials. Non-invasive reinforcement materials and reversible techniques are increasingly used. Foreign materials are introduced to reinforce weak areas,

enable reversible repair, and rescue valuable artefacts. Repair techniques are categorised based on recommendations from scholars, with each repair work preceded by studies and experiments support. However, there may still be loopholes or disagreements regarding the statement of work during project implementation, as some decisions can only be made on-site. Unexpected circumstances may arise during the demolition or addition of structures, leading to changes in conservation approaches and work instructions. Therefore, contract documents for conservation work should align with on-site processes, facilitating planning for repair techniques.

Timber-to-Timber Repair: Timber-to-timber repair involves adding new timber components to reinforce original members while minimising intervention in the historic timber. When original construction is impossible due to in-situ work or dismantling risks, damaged parts are cut and jointed with replacement timber. Using the same or similar timber species is preferred, as it exhibits similar behaviour in weathering and biodegradation. Traditional hand tools are often used to maintain authenticity and provide detailed work, although they may be slower and less consistent. Precise jointing without gaps is crucial for preventing water absorption and insect damage. Timber-to-timber repair addresses moderate damage from termite or fungal attacks, with patch or face repair and whole-section repair being common techniques. New fastenings like steel and epoxy resin adhesives may be used.

Timber With Foreign Material Repair: Some historic timber repairs involve using foreign materials, such as steel, to improve structural strength. These repairs often require the involvement of engineers and blacksmiths. Changes in the building's appearance are acceptable as long as they adhere to conservation principles. Repairs aim to retain original elements by reinforcing weak areas. The foreign material can serve different roles, including strengthening the original timber, replacing decayed ends, or providing additional support. Consolidation techniques using epoxy resin or carbon fibre are also employed. These research case studies do not fund epoxy resins or carbon fibre uses.

Epoxy Resin Infill Repair: Epoxy resin has been used in historic timber repair and strengthening since the 1960s. Its low curing shrinkage, good bonding, and ability to fill gaps make it suitable for consolidation and replacement purposes. While natural resin is traditionally used in Malaysia, synthetic or epoxy resin is not widely practised. Resin repairs are typically conducted on-site; the resin may be combined with other reinforcing or replacing materials. However, the darkened appearance of the resin is noticeable and should be considered when exposed members require a clear or natural finish. The use of resin in Malaysian conservation work is not widespread, perhaps due to cost factors or a lack of understanding among contractors. The preference for traditional timberwork techniques is always a priority, and foreign materials are the last choice. Based on the case study of this research, there were no repair works involving epoxy resin for timber structures at all.

Replication: Replication involves creating an exact copy of a building or its parts. The replication approach is decided in timber buildings when the historic timber is extensively damaged and beyond feasible repair. The remaining part of the building serves as a sample for replication, and old records like blueprints and pictorials may also be referred to. Replicas are sometimes created for display purposes to protect vulnerable values, particularly when craftsmanship faces threats of weathering, theft, or vandalism. Replication does not fully capture the authenticity of the heritage building, as it lacks historical value, memories, and embedded evidence. It is considered the last option in conservation work, primarily complementing the architecture of the building to resemble the original.

4. Historic Building Conservation in Malaysia

Many significant heritage buildings in Malaysia have been restored by relocating them for safeguarding purposes by the National Historical Societies and the Museums even before the Malaysian Heritage Department (JWN) establishment in 2006. The early conservation awareness movement in Malaysia started in 1945 when General Sir Gerald Templer made a policy speech emphasising the need to preserve the arts and crafts, leading to the establishment of the Arts Council of Malaya (Peninsular Malaysia), which successfully stimulated the Malayan artist and craftsmen. The first Malaysian heritage timber building restored was Ampang Tinggi Palace, a derelict Malay timber palace turned into the Negeri Sembilan State Museum in 1953 (Md Ali, 2016). It was the first adaptive reuse of old Malay traditional buildings recorded in Malaysia. In 1953, the 8th king of Negeri Sembilan (Yamtuan), Tuanku Abdul Rahman, granted permission for the old palace to be dismantled and relocated to Seremban. In 1980, the palace was moved again to its present location in the state museum. Istana Ampang Tinggi is 20.2m long and 7.1m wide and it was constructed with chengal timber without any iron nails. This allowed the building to be disassembled easily, transported to the new location and reassembled (Por, 2019).



Figure 4: Istana Ampang Tinggi at the current site in Seremban in 2019.

In 1967, another conservation project of the traditional building was safeguarding Kampung Laut Mosque (*Masjid Kampung Laut*), which faced severe riverbank erosion (Md Ali, 2016). The Kampung Laut Mosque is the oldest timber mosque in Southeast Asia. It was built in the 17th century without iron nails, like other early Malay buildings constructed before the 20th century. This mosque has a similar roof design to the Demak Mosque in Java, Kono Mosque in Champa, Nad Tanjung Mosque and Wadi Hussein Mosque in Thailand (National Archive of Malaysia, 2017). The historical significance is related to the early Islamic influence in Peninsular Malaysia. The mosque was built by Islamic missionaries who travelled along Champa and Java with the help of local people. The original site of this mosque was in Kampung Laut, Tumpat, on the banks of the Kelantan River (Tumpat District Council, 2017). Until 1966, this mosque was used as the centre of Islamic worship by the residents of Kampung

Laut. However, this mosque was damaged by the flood that struck Kelantan at the end of 1966 and early 1967. The State Government has closed the mosque and built a new mosque in a safer place. In November 1967, the State Government renovated the Masjid Kampung Laut Mosque in collaboration with the Malaysian Historical Society of the National Museum. It was reassembled at its new site in Nilam Puri at its new original site (Tumpat District Council, 2017). From 2020 to 2021, relocating the mosque has been done again for conservation reasons.

The Kampung Laut Mosque and the Ampang Tinggi Palace are those saved by reallocating from their original location, made possible due to the timber construction technology. These are the unique methods practised in Malaysia. Unlike in Western conservation, building dismantling for relocation is practised in most Southeast Asian countries, such as Japan and Thailand, either for cultural or religious reasons (Orbasli, 2008). Dismantling of the timber building part effectively detects the decay in hidden places and facilitates refurbishment work on each building part (Brown, 2013). The ability to dismantle and reassemble the timber building parts enables more detailed work rather than in-situ repairs. In addition, reallocating the building will also save the building from the risk of damage due to site conditions.



Figure 5: The Kampung Laut Mosque. Left; The mosque at its original site in 1966 after the river banks were eroded by heavy floods (Akib, 2003), and right; the mosque is well preserved at its new location in 2017.

Malaysia's last Malay Timber palace was built at Seri Menanti, Negeri Sembilan. Seri Menanti Palace construction began in 1902 and was completed in 1908. It was the official residence of the Yang DI-Pertuan Besar, Tuanku Muhammad, until 1931 (Sheppard, 1986). The building has been through several repairs until the latest repair of its decayed main pillars in 2017 (Ibrahim, 2019). The repair involved the work of cutting its main columns that had rotted and jointed with new timber. The rotten parts stem from rainwater from roof leaks and seeped into the columns over time. The interior condition slows down the evaporation, which catalyses the rot. In 1992, DYMM Tuanku Jaafar Ibni Almarhum Tuanku Abdul Rahman instructed the palace to be designated as 'The Royal Museum' under the management of the State Museum Administration. Seri Menanti Palace has changed its function from a residence to a place to exhibit the collections of the royal family. Each room has been filled with displays without changing the original form of the palace to show its original space function (Shahminan *et al.*, 2019). In 2017, the palace was identified as unsafe, and immediate action to safeguard

the palace started until its completion in early 2019. However, further repair work is in the pipeline, including landscaping work (Rahman, 2019).



Figure 6: The Seri Menanti Palace. Top; The palace front view before the conservation work and below; the replacement timbers on-site view during the conservation work in 2017.

In Kuala Kangsar, Perak, the Kenangan Palace, built in 1923, underwent major conservation in 2017. However, it was built as a temporary palace while the actual palace was still constructed during that time. Later, the Istana Kenangan became the royal family's residence (Muhammad *et al.*, 2012). It retains the significant Perak royal identity with the coloured bamboo weaving walls. The 2017 conservation work involved replacing damaged parts of the building due to roof leaks and raised ground moisture. A few modifications have been made between the columns and stumps to prevent the same moisture problems from recurring. The traditional timber palace was originally able to be dismantled part by part. However, the repairs done in the past with steel-reinforced timber members to support the main structure from damages due to the ground movement had changed this dismantlable timber building to a permanent one.



Figure 7: The Kenangan Palace, Kuala Kangsar, Perak. Left; the Palace before conservation, and right; during the conservation work in 2017. (Source: Author, 2017)

The related literature review found that every heritage timber building conservation project has its own unique issues and situations. The intention to conserve and the damages suffered, the year built, which in turn affects the construction techniques employed. Therefore, conservation planning needs to be drawn up at an early stage, taking into account various factors, including the selection of professionals and experts who will be involved. Consequently, the preparation of contract documents should consider the level of understanding of all parties involved. The involvement of amateurs in heritage building repair work should be anticipated. Building conservation work requires a clear understanding of the actions and steps to ensure the smooth running of the project. The planning of a conservation project is based on the principles, methodologies, and techniques that guide the conservation team. Conservation projects are often referred to as efforts to safeguard and prolong the building, involve the work of restoring, repairing, consolidating, adaptive reused and maintaining buildings. Misunderstanding these terms and practices will cause the conservation project to be implemented only by covering the repair of the building as the original without considering the philosophy behind preserving the values and the histories embodied (Kamal and Ab Wahab, 2014). The conservators, contractors, and carpenters collectively play a significant role in the repair works. Conservators ensure adherence to conservation principles while contractors carry out the repair works. Malaysia is a country that has long been aware of the importance of preserving heritage since before its independence. However, significant efforts towards implementing world-class building conservation practices began with the establishment of The National Heritage Department (JWN) and the National Heritage Act in 2005. Consequently, many building professionals are currently gaining recognition in the field of heritage building conservation.

5.0 Contractor and Conservator Historic Timber Repair Viewpoint

The case study of this research is one of the conservation projects for historic timber buildings in Malaysia, which took 24 months to complete on-site repair works. The observation survey was conducted throughout the project duration on-site, and the researcher was directly involved in every meeting and discussion related to timber repair works with the contractor. The contractor referred to in this context includes the builder and the carpenter of

the project. The literature review and on-site observations have identified the key elements in the Historic Timber Repair Work (HTRW), which are thereafter used as the unit of analysis for this research. The on-site observation survey is the method applied to obtain the viewpoints on four key elements found in timber repair works. The key elements (analysis) are the replacement timber (new timber used to replace the damaged original timber), the historic timber (the remaining original timber that is still in good condition to preserve), the timber repair works techniques, and the conservation principles and concept complied. The on-site observation survey is an opportunity to observe the carpenter's understanding of conservation intention on HTRW, which was discussed among the professionals involved throughout the HTRW timeframe. The contractor that is referred to also includes the carpenters who work on behalf of the project's contractor. The awarded contractor conducting the conservation projects is a regular contractor with no HTRW or building conservation work experience. Therefore, information and supervision by on-site conservators played a significant role in projects. The observation survey search about the contractor's intent in repairing the historic timber structure (HTS) found that the contractor is more concerned with the HTS functioning as the original through the method they thought which most efficient. Nothing should save or remain if it affects their work efficiency. The carpenter focuses on restoring the building to its function with regular carpentry practices. Meanwhile, a discussion with the site conservators to set the HTRW method. The conservators first intended to protect as much as the HTS, with minimum intervention, and possibly expose the effects of the repairs without touch-ups to mimic the original. At the same time, the knowledge and experience of the respective carpenter are concerned and appreciated to take into account in repair decisions. The final decision is decided by conservators (consultant and contractor).

A survey of observations found and concluded that the experience of replacing new or repairing HTS alone does not guarantee one can appreciate the concept of conservation in HTRW. This is because the HTRW involves knowledge of constructions or repairs and is concerned about saving significant historical evidence. The appointed contractor engaged in the projects is experienced with timber works. However, the 'contractor' versus 'conservator' understanding of restoring the historic timber building was found to have some conflicts. The comparison of their way of thinking (viewpoint) is listed in Table 1, matrix-matched with the four research analysis units (key elements). These data were obtained based on observations by the researcher during the conservation project conducted on-site.

Table 1: Observation Analysis Tabulation on Contractor and Conservator Historic Timber Repair Works Viewpoint

		Analysis 4
		Conservation Principle
	Contractor's Viewpoint	Conservator's Viewpoint
Analysis 1 Replacement Timber	Replace with either the same or other species depending on its purposes.	Replace with the same species as historic timber or at least with the same grade of timber. Replacement as same as possible with the original.
	Recommend additional components for practical and rational reasons for weak HTS.	Try to save as much as possible and preserve the original construction. Additional is a last option for consolidation and safeguarding.
Analysis 2 Historic Timber	Less care for the existing on-site surroundings. Focus on the progress of the repair work to meet the timeframe.	The building is considered old and fragile. Every job needs to be done carefully and take precautions in the building.
	Seeing a building as a normal function.	Seeing a building as its current function. At the same time, preserve the evidence embedded for reference to history and culture.
	Replace the whole affected.	To save as much as possible historic timber portion and parts.
	Not sensitive to possible historical evidence found on the existing structure during work on site.	Always expecting and finding cultural/historical evidence that is possible can be found in many forms.
Analysis 3 Timber Repair Work Process	Intent to the neat and clean outcome	differentiate which old and new
	Using the usual techniques is most preferred	Implementing the original construction method is recommended.
	Don't mind if the repairs affect the other related or attached components as long the problem is solved.	Avoid intervention/harm in the original structure in repairs. Focus on the problem areas.
	Efficient and effective solution.	Reversible and exposed solution
	Fast and simple	Starts with the investigation and thorough
	The work is based on carpentry theories and experiences.	The work complies with the related conservation guideline.
	Completing replacement and new construction to neat work result.	Expose and truthfulness of the new replacement or construction modification for future reference.
	Short-term work planning. Intent to complete the repairs in situ.	Records every work and findings on-site for future reference, such as tagging the repaired building elements.

The researcher obtained information about the repair work process through the in-depth observation survey conducted on a heritage timber building in Malaysia and interviews with several authorised local conservators and builders. At the same time, important data that can only be obtained through in-depth observation on life conservation projects is about the way of thinking and work ethic demonstrated between the contractors and the conservators. The data obtained is from the contractors and conservators that worked on the same project. Table 1 presents the observation results on communication between the highly experienced conservator and the contractor who first conserved the historic timber building. The findings of this analysis are very helpful in developing or upgrading the current guidelines as well as the on-site repair work method statement. The findings also bridge the understanding of each party, namely contractors and conservators, towards facilitating on-site discussions and project meetings.

5.0 Conclusion

Malaysian current practice in historic building conservation often involves various professions, and not all of them understand the concept of conservation. Reference from standard local and international timber building conservation guidelines is always written in general. Without vast experience, misinterpretation of conservation concepts probably happens. In building repair work, the contractor is the main party. In other words, the contractor's viewpoint is the usual objective for building or repairing ordinary buildings. In contrast, the conservator's viewpoints are the objective of restoring historic buildings, where the concept of conservation is considered. The concept of conservation based on the Malaysia National heritage department is to save the historical and cultural significance of the building by taking into account the building's authenticity from the aspects of material, workmanship, design and setting (Jabatan Warisan Negara, 2017). Therefore, historic timber repairs are not just about restoring the building to serve back to the original as well as rehabilitation but also respecting the building as a valuable artefact.

The findings of this research (the viewpoints) can be refined to present in conservation project briefings for practitioners who are first involved with historic building conservation projects, especially the contractors, carpenters or craftsmen. The briefing gave a clearer understanding of the concept of conservation and support for the standard guideline used. Disclosure of these viewpoints helps the first-timer better understand the historic building conservation concept. Meanwhile, the conservator is aware of the contractor's level of understanding and way of thinking that most of them do not understand the concept of conservation so as not to be overlooked during work monitoring. The historic timber repair viewpoints are also helpful for heritage masonry buildings' timber structures or components, not limited to fully timber buildings.

References

- Ahmad, Y. and Woods, P. (2000) 'Building Conservation in Malaysia: Current Practice & Challenges', in Ngim and Tay, L. (eds) *80 Years of Architecture in Malaysia*. Kuala Lumpur: Pertubuhan Akitek Malaysia, pp. 36–41.
- Akib, S. M. (2003) *Masjid Tua Kampung Laut*. Kota Bharu, Kelantan, Malaysia: Perbadanan Muzium Negeri Kelantan.
- Brown, A. (2013) *The Genius of Japanese Carpentry*. Revised Ed. Hong Kong: Tuttle Publishing.
- Corradi, M., Osofero, A. I. and Borri, A. (2019) 'Repair and Reinforcement of Historic Timber Structures with Stainless Steel — A Review', *Multidisciplinary Digital Publishing Institute*, pp. 1–23. doi: 10.3390/met9010106.
- English Heritage (2012) *Practical Building Conservation: Timber*. London: Routledge.
- Feilden, B. M. (2003) *Conservation of Historic Building*. 3rd Editio. Elsevier & Architectural Press.
- Forsyth, M. (2008) *Materials & Skills for Historic Building Conservation*. Oxford: Blackwell Publishing Ltd.
- Friedman, D. (2000) *The Investigation of Buildings*. New York, London: WW Norton & Company.
- Gibbs, P., Rahman, Y. A. and Kassim, Z. (1987) *Building a Malay House*. Singapore.
- Harun, S. N. (2005) *Amalan Kerja Pemuliharaan Bangunan Bersejarah Di Malaysia*. Universiti Sains Malaysia.
- Harun, S. N. et al. (2010) *Pemuliharaan Bangunan Bersejarah*. Shah Alam, Selangor, Malaysia: Universiti Teknologi MARA.
- Harun, S. N. (2011) 'Pemuliharaan Warisan Kebudayaan: Masjid Lama Kampung Kuala Dal, Kuala Kangsar, Perak', in *Seminar Antarabangsa Warisan Nusantara & Kraf Warisan*.
- Hopkirk, E. (2018) 'Some precious Mac relics and part of rebuilt library are safe', *Building Design*, (June), pp. 3–9. Available at: www.bdonline.co.uk.
- Hughes, N. (2019) 'Tenders for Conservation Work', pp. 2–3.
- Ibrahim, A. (2019) *Seminar Pemuliharaan Istana Lama Seri Menanti (Muzium Diraja)*.
- ICOMOS (2017) 'Principles for the Wooden Built Heritage (2017)', pp. 1–6.
- ICOMOS Singapore (2019) 'Structure', *Conservation technical handbook*, 4.
- Insall, D. W. (1975) *The Care of Old Buildings Today: A Practical Guide*. London: The Architectural Press.
- Jabatan Warisan Negara (2017) *Garis Panduan Pemuliharaan Bangunan Warisan*.
- Kamal, K. S. and Ab Wahab, L. (2014) *Bangunan Bersejarah: Kerosakan dan Penyataan Kaedah Pemuliharaan*. Shah Alam, Selangor, Malaysia: Universiti Teknologi MARA Press.
- Karakul, Ö. (2015) 'An integrated methodology for the conservation of traditional craftsmanship in historic buildings', *International Journal of Intangible Heritage*, 10(January 2015), pp. 135–144.
- Larsen, K. E. and Marstein, N. (2016) *Conservation of Historic Timber Structures*. Butterworth-Heinemann.
- Md Ali, Z. (2016) *Mubin Sheppard: Pioneering Works in Architectural Conservation in Malaysia*. Kuala Lumpur: University Of Malaya Press.
- Muhammad, A. et al. (2012) 'The Study of Traditional Malay Decoration and Wood Carving A Case Study of The Istana Kenangan, Kuala Kangsar, Perak..pdf', in *The 9th Regional Symposium of The Malay Archipelago 2012*. Seri Iskanadar, Perak: Universiti Teknologi

- MARA (Perak Branch).
- Orbasli, A. (2008) *Architectural Conservation*. Oxford: Blackwell Science.
- Park, T. L. (2013) 'Process of architectural wooden preservation in Japan', *WIT Transactions on The Built Environment*, 131(Vol 131), pp. 491–502. doi: 10.2495/STR130411.
- Por, O. S. (2019) 'Istana amfang tinggi, negeri sembilan', *The Institution of Engineers, Malaysia JURUTERA*, p. 25.
- Rahman, A. A. (2019) *Skop Kerja, Laporan Dilapidasi dan Kaedah Serta Teknik Pemuliharaan: Istana Lama Seri Menanti, Seminar Pemuliharaan Istana Lama Seri Menanti*.
- Rashid, M. S. A. (2007) *Kajian Senibina Pada Elemen Estetik dan Ragam Hias Seni Bina Tradisiaonal Melayu: Kajian Kes Seni Bina Gaya Pantai Timur*. Universiti Sains Malaysia.
- Ross, P. (2002) *Appraisal and repair of timber structures*, *Structural Engineer*. London: Thomas Telford. doi: 10.1680/arts.61781.
- Russell, R. (2016) 'Structural Timber Repairs', pp. 3–5. Available at: <http://www.buildingconservation.com/articles/structural-timber-repairs/structural-timber-repairs.htm>.
- Sabil, A. and Utaberta, N. (2017) *Tanggap Rumah Melayu*. Kuala Lumpur: Dewan Bahasa dan Pustaka.
- Saod, S. M. (2019) *Pemuliharaan dan menaiktaraf istana lama seri menanti*.
- Shahminan, R. N. R. et al. (2019) *Istana lama seri menanti*.
- Sheppard, M. (1986) *A Royal Pleasure Ground. Malay Decorative Arts and Pastimes*. Oxford University Press.
- Tan Yeow Wooi (2015) *Penang Shophouses: A Handbook of Features and Materials*. Penang, Malaysia.
- Yeomans, D. (2003) *The Repair of Historic Timber Structure*. London: Thomas Telford.
- Yeomans, D. T. (2008) 'Repairs to historic timber structures: changing attitudes and knowledge', *Structural analysis of historic construction: preserving safety and significance: proceedings of the Sixth International Conference on Structural Analysis of Historic Construction, 2-4 July 2008, Bath, United Kingdom*, pp. 63–70.
- Yusof, M. A. M. (2014) *Seni Bina Malaysia; Warisan Dalam Kepelbagaian*. Kuala Lumpur: Jabatan Muzium Malaysia.